The advantages of the method over the older method are :

(a) remote control eliminates manual rotation of torsion head, thus reducing the effects of vibration, etc.

(b) since the balancing force is applied directly on the sample itself, no torsion on the suspension fibre is required and the system remains perfectly undisturbed.

(c) electric currents can be very accurately measured.

(d) the balance chamber can easily be made vacuum-proof and can be kept dry.

The method has been tried experimentally and the instrument was found to work satisfactorily. Details will be published later.

My thanks are due to Professor A. Bose for his kind interest in the work.

3

INTERMOLECULAR POTENTIALS OF H_2 AND D_2

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The importance of the quantum effects for H_2 and D_2 at low temperatures makes the determination of their potential energy functions very interesting. Further, it is likely to show whether their potential energy functions are the same, as it should be for two isotopes, provided their non-spherical nature may be neglected. Although it is known that there should be some difference in the inter-molecular potentials of H_2 and D_2 due to the difference in their zero-point energies, it was so long thought that this effect can be neglected (Mason and Rice, 1954). Moreover the earlier experimental data were not accurate enough to test this conclusively. Very recently Michels *et al.* (1960*a*) have determined the second and third virial coefficients of H_2 and D_2 by using a precise method (Michels *et al.* 1960*b*) utilising their compressibility data (Michels, et *al.* 1959) between the temperature range from $-175°C$ to $150°C$. They have observed that the force constants for H_2 and D_2 determined previously on the L–J (12 : 6) model cannot represent the virial data satisfactorily. Hence they have redetermined the force

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constants for H_2 and D_2 and have found them to differ from each other by more than what can be ascribed to be experimental errors. They have also considered the non-spherical nature of the potential energy functions to represent the virial data.

It was therefore considered desirable to have a more detailed investigation of the intermolecular potentials of H_2 and D_2 to test whether the results obtained by Michels *et al.* (1960a) are true for other potentials as well. We have thus fitted the second virial coefficient, $B(T)$, data of Michels *et al.* (1960a) to the exp-six model by taking into consideration the quantum effects. The results obtained are shown in Table I. In Table II the experimental and the calculated values of $B(T)$ are shown. For the sake of comparison the values calculated on the exp-six model from the force constants determined by Mason and Rice (1954), and those calculated by Michels *et al.* (1960a), are also shown.

It may be seen from the Tables I and II that the results obtained on the exp-six model confirm the finding of Michels *et al.* (1960*a*) that the force fields of H_2 and D_2 are not exactly the same. However, the agreement with the experimental data calculated on the exp-six model from the force constants determined by us is very good over the entire temperature range and hence further consideration of the non-spherical nature of the potentials may not be necessary.

TABLE I

Force parameters for H_2 and D_2 on the exp-six model

Substance	Present work			Mason and Rice (1954)		
	α	ε/k °K	r_m Å	α	ε/k °K	r_m Å
H_2	14.0	38.02	3.339	14.0	37.3	3.337
D_2	14.0	37.33	3.334	Assumed to be the same as those of H_2		

It is to be noted that Michels *et al.* (1960a) could not find agreement in the whole temperature range with their force constants on L—J (12 : 6) potential model, within the experimental accuracy. Thus it appears that the exp-six potential model is an improvement over the L– J (12 : 6) model which has been already pointed out by Mason and Rice (1954).

Further work, by taking into consideration the third virial coefficient and the quantum corrections to the transport coefficients, is in progress.

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TABLE II

Second virial coefficient for H_2 and D_2 in cm^3 $mole^{-1}$

$T°K$	Hydrogen				Deuterium		
	Calculated			Expt.	Calculated		Expt.
	Exp-6 present work	Exp-6 Mason &Rice	L–J(12-6) Michel *et al.*		Exp-6 present work	L–J(12-6) Michel *et al.*	
98	−3.14		−3.16	−3.06	−4.48	−4.35	−4.59
103	−1.69		−1.76	−1.69	−2.93	−2.84	−3.03
113	+0.62		0.68	0.67	−0.38	−0.30	−0.38
123	2.79	3.34	2.71	2.63	1.78	1.78	1.79
138	5.18		5.10	5.01	4.38	4.29	4.38
153	7.05		6.95	6.89	6.26	6.19	6.36
173	9.01	9.27	8.82	8.84	8.25	8.20	8.37
198	10.66		10.60	10.65	10.22	10.07	10.20
223	12.06	12.24	11.93	11.98	11.52	11.45	11.53
248	12.99		12.95	12.97	12.54	12.51	12.53
273	13.73	13.93	13.75	13.76	13.31	13.34	13.30
298	14.36	14.51	14.40	14.38	13.98	14.00	13.90
323	14.86	14.97	14.92	14.87	14.46	14.53	14.38
348	15.22	15.34	15.34	15.27	14.87	14.97	14.76
373	15.59	15.63	15.69	15.60	15.27	15.33	15.07
398	15.86	15.88	15.97	15.86	15.41	15.63	15.33
423	16.05	16.07	16.21	16.08	15.62	15.87	15.54

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